which were practically the same as those for normal animals. The potassium excretion studies show that the adrenalectomized rats maintained on salt excrete potassium as the normal intact animal, while those not given salt have a diminished excretion of the total potassium and furthermore they retained a greater percentage of the administered radioactive potassium than did the normal animals.

Summary. (1) Radioactive isotopes of sodium and potassium furnish a new method of study of the physiology of the adrenal cortex. (2) Adrenalectomized rats, unsupported by salt treatment, have an increased total sodium excretion and increased rate of excretion of administered radioactive sodium when contrasted with normal animals; the reverse is true of potassium. (3) Simple access to a 1% solution of table salt enables adrenalectomized rats to handle sodium and potassium in a way resembling that of normal rats.

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I. A Murine Typhus Virus Isolated from a Patient in Peiping, China.*

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Although Gajdos and Tchang[1, 2] and Wu and Zia[3] worked on several local orchitic strains of typhus fever virus, their studies were chiefly limited to observations on guinea pigs. In view of the fact that slight scrotal swelling may occur in from 2 to 22% of male guinea pigs infected with the "epidemic" or human virus,[4, 5] and that the latter virus and the "endemic" or murine virus are known to have a definite cross immunity in guinea pigs, we feel that before the local orchitic strains are identified with the murine virus, it would be of some importance to study the behavior of these strains in the

* The authors are indebted to Dr. Samuel H. Zia for supplying them with a Mexican typhus virus, and for his many valuable suggestions.

1 Gajdos, E., and Tchang, J., *Studies on Typhus Fever in China,* Catholic University Press, Peiping, 1933.

2 Gajdos, E., and Tchang, J., *Arch. Inst. Pasteur, Tunis,* 1934, **23**, 37.

3 Wu, C. J., and Zia, S. H., *Chinese Med. J.,* 1938, Suppl. II, 221.

4 Biraud, Y., and Deutschman, S., *League of Nations Epidem. Report,* 1936, **15**, 99.

5 Mooser, H., Varela, G., and Pilz, H., *J. Exp. Med.,* 1934, **59**, 137.

rat and mouse, especially since one of the strains studied by Gajdos and Tchang, which produced scrotal swelling in male guinea pigs, when later brought to Tunis, was found by Sparrow[6] to cause only an inapparent infection in rats, and by Durand and Hombourger[7] to be incapable of surviving beyond 3 passages in mice. This communication reports the results of a study on a local strain which we isolated in November, 1937, from the blood of a typhus fever patient, and which, we have found, possessed most, if not all, of the reported experimental characteristics of the murine virus in the guinea pig as well as in the rat and mouse.

Our virus has now been passed through guinea pigs for 27 generations. In transferring the virus, inoculations were made with brain, tunica or brain-tunica emulsions from these animals. Sixty-seven guinea pigs were used, 55 of which were males. Among the 25 guinea pigs employed during the first 10 generations, 21 were males. Six of these animals weighed between 200 and 300 g, and perhaps should not be expected to show any scrotal swelling. Ten of the 15 adult male guinea pigs exhibited marked or moderate scrotal swelling. However, since the 11th generation the scrotal swelling has disappeared. It reappeared only once in 2 animals of the 16th generation and was moderate in one and slight in the other. This disappearance of scrotal swelling on prolonged transfers in guinea pigs has also been the experience of Gajdos and Tchang, and of Wu and Zia working on local strains, and of Lépine[8] and Mooser[5] working on typical murine strains. In most of our guinea pigs showing no appreciable scrotal swelling, there were various degrees of congestion and exudation in the tunica vaginalis, from which typical Rickettsia bodies could usually be demonstrated, provided the animals were killed during the first few days of fever. In some of the animals killed on the 11th to the 14th day of fever, typhus nodules were either absent or scanty in the brains. The incubation period was relatively short, varying in the majority of our animals from 4 to 8 days. Two guinea pigs infected with our virus were found 6 weeks later to be completely immune against the Mexican virus, when inoculated with one-tenth and one-fifth of an infected brain respectively, whereas the control animals developed both fever and scrotal swelling.

The brain of a guinea pig of the 15th generation was inoculated intraperitoneally into 3 albino rats. Since then we have successfully

[6] Sparrow, H., *Arch. Inst. Pasteur, Tunis*, 1935, **24**, 56.

[7] Durand, P., and Hombourger, K., *Arch. Inst. Pasteur, Tunis*, 1935, **24**, 70.

[8] Lépine, P., *Arch. Inst. Pasteur, Paris*, 1933, **51**, 290.

carried the virus from rat to rat for 12 generations.[9] Guinea pigs were inoculated with the brains of rats of alternate generations. All of the 12 guinea pigs used showed typical fever, and in 6 of them there was a return of slight and transient scrotal swelling. For serial transfers the rats were sacrificed 12 to 14 days after infection. We have found that the brains of rats 30 days, 40 days and 90 days after infection with our virus were still infectious on inoculation into guinea pigs, showing that the virus could survive in the rat for as long as 3 months.[10] The majority of the 30 rats used in this series showed a febrile reaction (38.1°-39.3°C) lasting from 1 to 13 days after an incubation period of from 3 to 8 days.[11, 12] Typical Rickettsia bodies could be found in moderate numbers in the tunica vaginalis and occasionally in small numbers in the peritoneum, when the rats were killed 5 or 6 days after infection by the intraperitoneal route. We have succeeded in producing a heavy infection of the peritoneal cavity in benzolized rats inoculated with a saline suspension of tunica vaginalis of a guinea pig infected with a Mexican virus,[13] but 3 similar attempts made with our own virus have all failed. However, it is to be noted that in the latter case we used brain as inoculum instead of tunica vaginalis inasmuch as this experiment was started after our virus had been passed through guinea pigs for 20 generations and no longer produced scrotal swelling in these animals. A Weil-Felix test was done on the sera of 10 rats killed from 5 to 11 days after infection; 4 showed a negative reaction at a titer of 1:10, 1 a positive reaction at 1:10; 2 at 1:20; 1 at 1:80, and 2 at 1:320.

The brain of a guinea pig of the 16th generation was inoculated intraperitoneally into a series of mice. Subsequently the virus was passed through 7 generations of these animals at intervals of 10 days. The brains of the mice of the 2nd and the 5th generations were found to be infectious on subcutaneous inoculation into guinea pigs. These animals developed typical fever and agglutinins for Weigl vaccine in their sera.[14] Furthermore, typical intracellular Rickettsia bodies could often be demonstrated, though not always, in smears from the tunica vaginalis and the peritoneum of the mice up to the 7th generation.[15] They could be found as early as 48 hours after infection by the intraperitoneal route, but in large

[9] Nicolle, C., *Arch. Inst. Pasteur, Tunis*, 1933, **21**, 349.
[10] Nicolle, C., and Laigret, J., *Arch. Inst. Pasteur, Tunis*, 1933, **21**, 357.
[11] Mooser, H., *J. Inf. Dis.*, 1929, **44**, 186.
[12] Maxcy, K. R., *U. S. Pub. Health Rep.*, 1929, **44**, 1935.
[14] Laigret, J., and Jadin, J., *Arch. Inst. Pasteur, Tunis*, 1933, **21**, 381.
[13] Zinsser, H., and Castaneda, M. R., *J. Exp. Med.*, 1930, **52**, 649 and 865.
[15] Okamato, Y., *Kitasato Arch. Exp. Med.*, 1937, **14**, 99 and 113.

numbers only after the 4th or 5th day. After the 9th day they became mostly extracellular and began to disappear.[15]

Summary. A typhus virus was recovered from the blood of a patient with typhus fever and was found to conform to the murine type in its behavior in the guinea pig, rat and mouse.

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II. Typhus Virus Isolated from Rats and Rat-fleas in Typhus Houses.*

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In our previous communication,[1] a virus of the murine type isolated locally from the blood of a patient with typhus fever was described. Recently Wu and Zia[2] recovered a typhus fever virus from the pooled brain emulsion of 3 out of 139 rats trapped from different households in this city, thus verifying the assumption that the rat serves as a reservoir host for the disease in this locality. It appeared to us, that to complete the evidence of a rat-flea-man cycle of transmission, it would be necessary to recover typhus fever virus from rats and rat-fleas caught in the houses of typhus fever patients who were suspected, on clinical and epidemiological grounds, to be suffering from the murine variety of the disease. This communication reports the observations on 2 rat-strains and 3 flea-strains of typhus fever virus obtained in this manner.

In October, 1938, four typhus fever patients from widely scattered parts of the city were seen in this hospital. They were cleanly in their habits and gave no history of contact with the body louse. Their disease ran a very mild clinical course. In the homes of 2 of the patients whose Weil-Felix reaction titer exceeded 1:2560, there was evidence of heavy infestation with rats. These were trapped for study. One rat† was caught on October 19th in the house of the

* The authors are indebted to Dr. K. H. Pang for growing one of the rat-strains on Maitland's and Zinsser's tissue media.

1 Liu, W. T., and Chung, H. L., PROC. SOC. EXP. BIOL. AND MED., 1939, **40**, 350.

2 Wu, C. J., and Zia, S. H., PROC. SOC. EXP. BIOL. AND MED., 1938, **39**, 163.

† Six other rats were caught in the same house but were not brought to us for study.